CFOSAT: possible contribution of the Sea State Dedicated mission to CCI project

sea state cci

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CFOSAT ready to serve climate purposes

Cf Daniele Hauser Keynote you are probably conviced that CFOSAT:

- Is a great mission ☺

- Has finished its 1st validation step

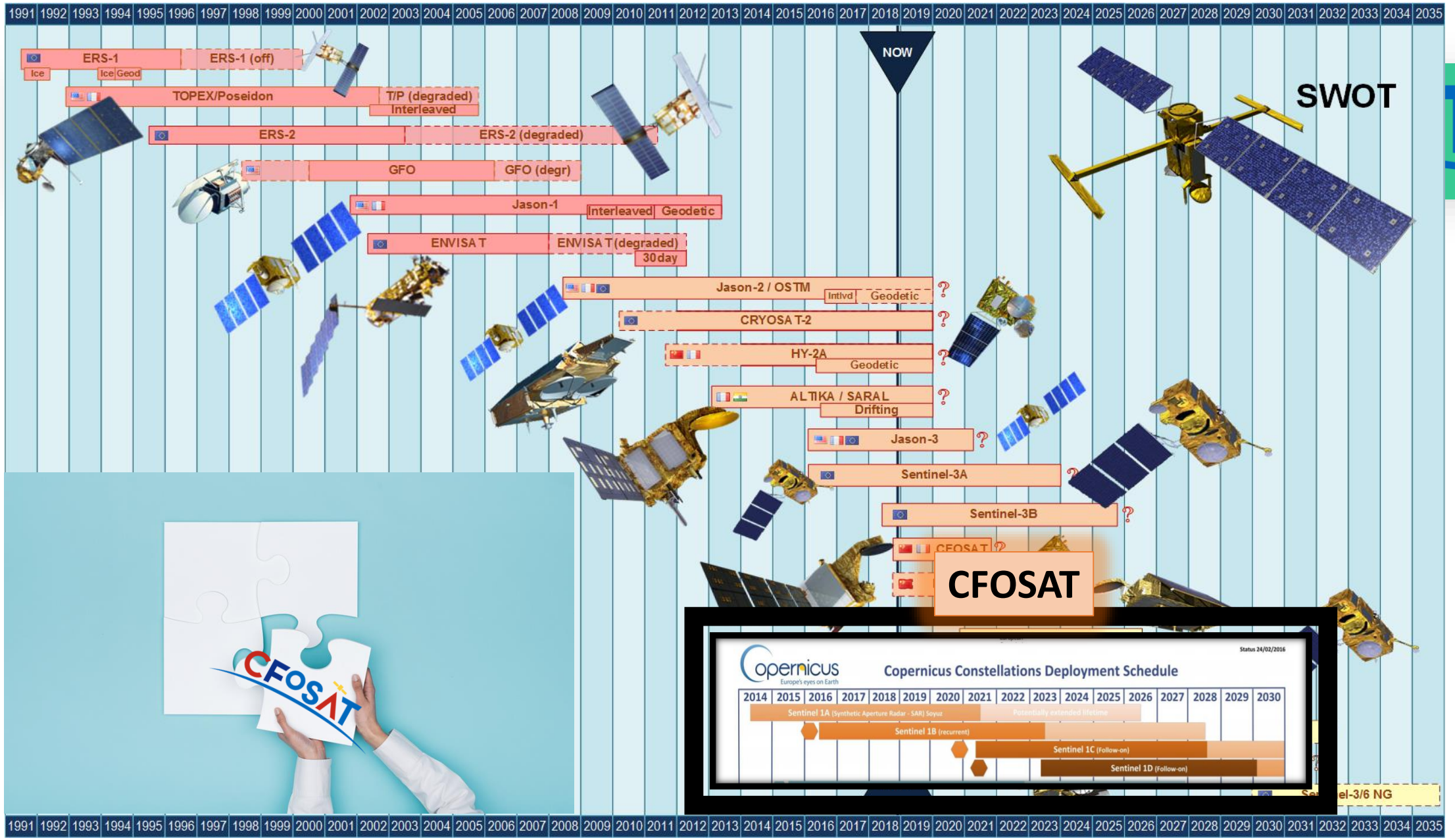
The ST Meeting held last week concludes that:

- CFOSAT data analysis is already entered into the era of scientific exploitation
- It needs to be more widely promoted towards end users

Aim of this presentation is to present the most direct and convinient way for the CCI project to take advantage of the calval work performed by the teams upstream.

It aims at opening a dialogue between users needs and the CFOSAT project to answer them thanks to:

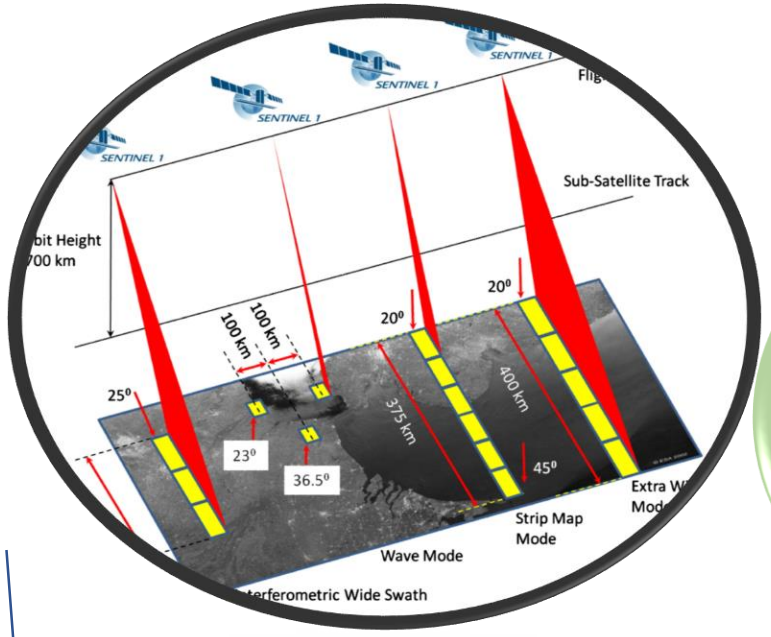
- Upstream calval studies and potential adéquation to Climate needs
- Strategy of application dedicated products
  - For nadir products
  - For off nadir products



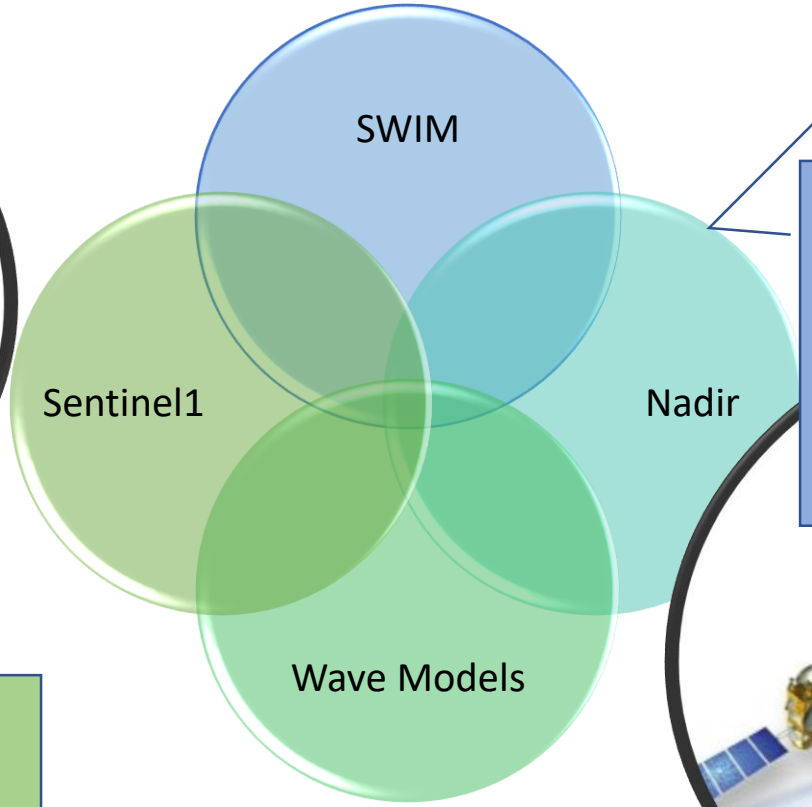
CFOSAT is of great interest for Sea State Climate purpose. Double technique nadir and off nadir

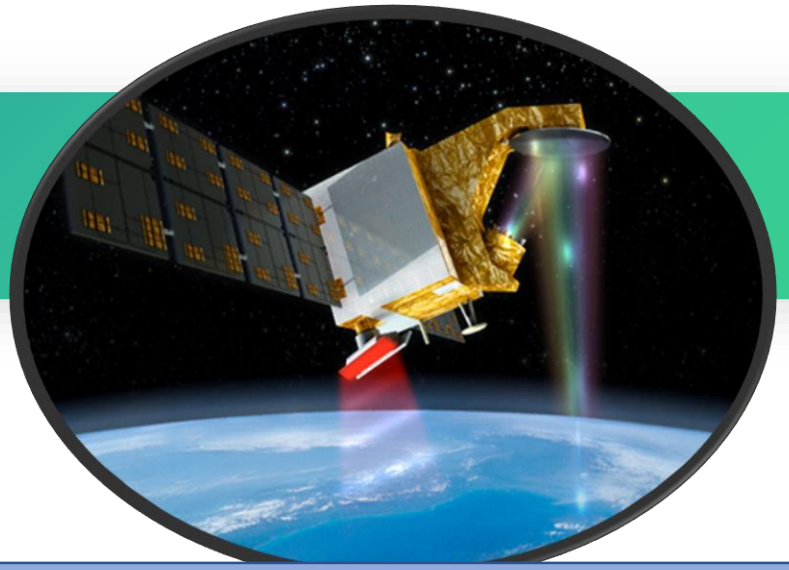
Could enable to joint both historical data series and constellations: Nadir and Sentinel1

CFOSAT: Joining the 2 historical climat series?



Systematic monitoring via MPC-S1 diagnosis: http://oceanwavesremotesensing.ifremer.fr/s1b/partitions-202102.html

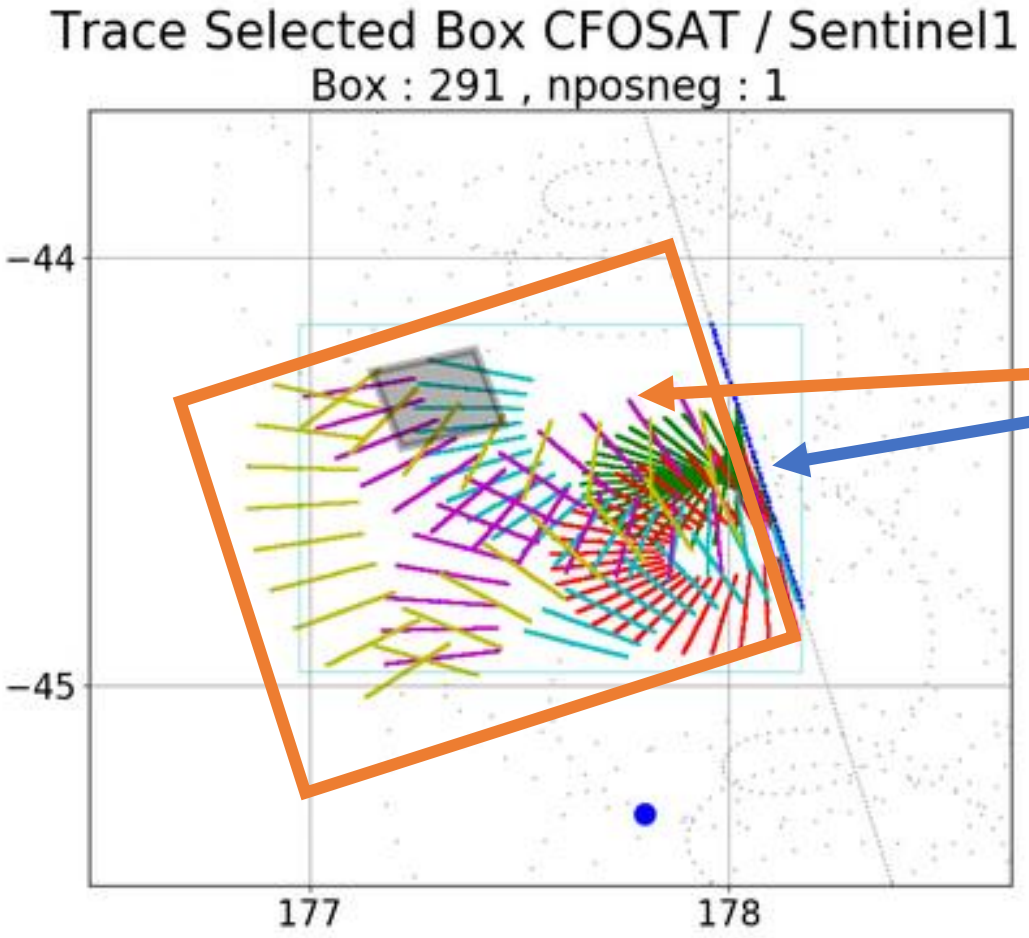


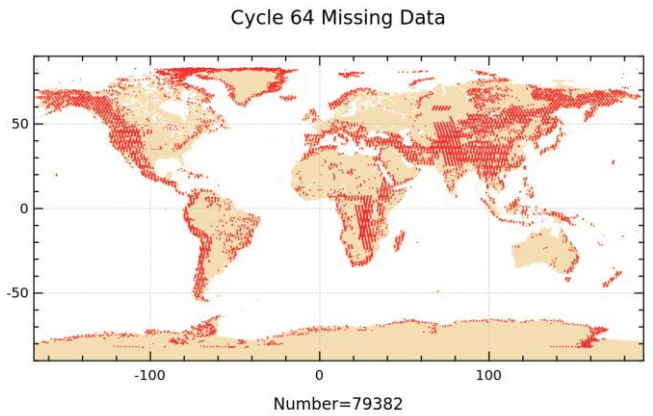


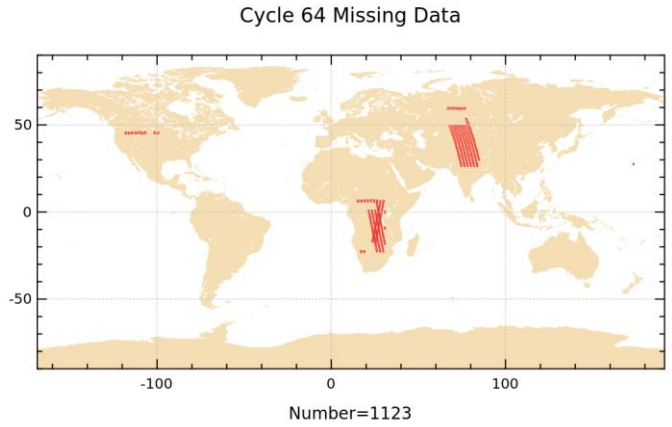
Systematic monitoring links on Aviso:

- Synthetic Calval Reports: https://www.aviso.altimetry.fr/fr/data/calval/systematic-calval/bilans-de-validation-calval/swim-cfosat.html
- Off lines diagnosis including L2S products http://oceanwavesremotesensing.ifremer.fr/cfosat/

Very good Coverage



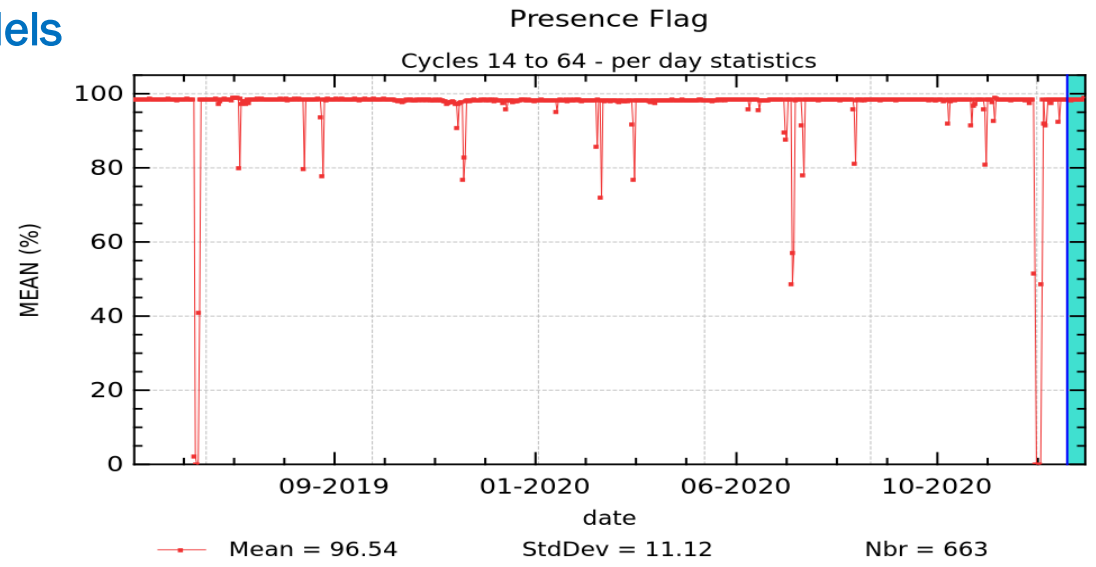




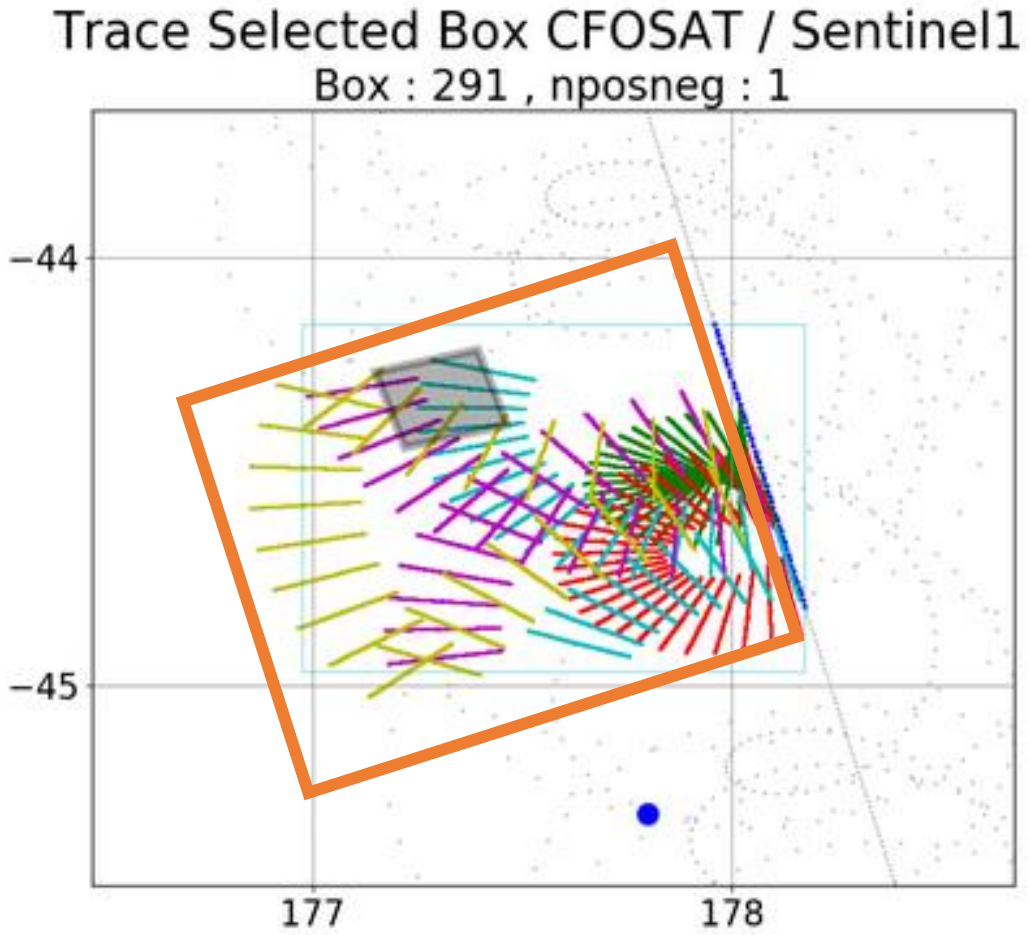
Very good coverage > 96% up to Latitude 83°

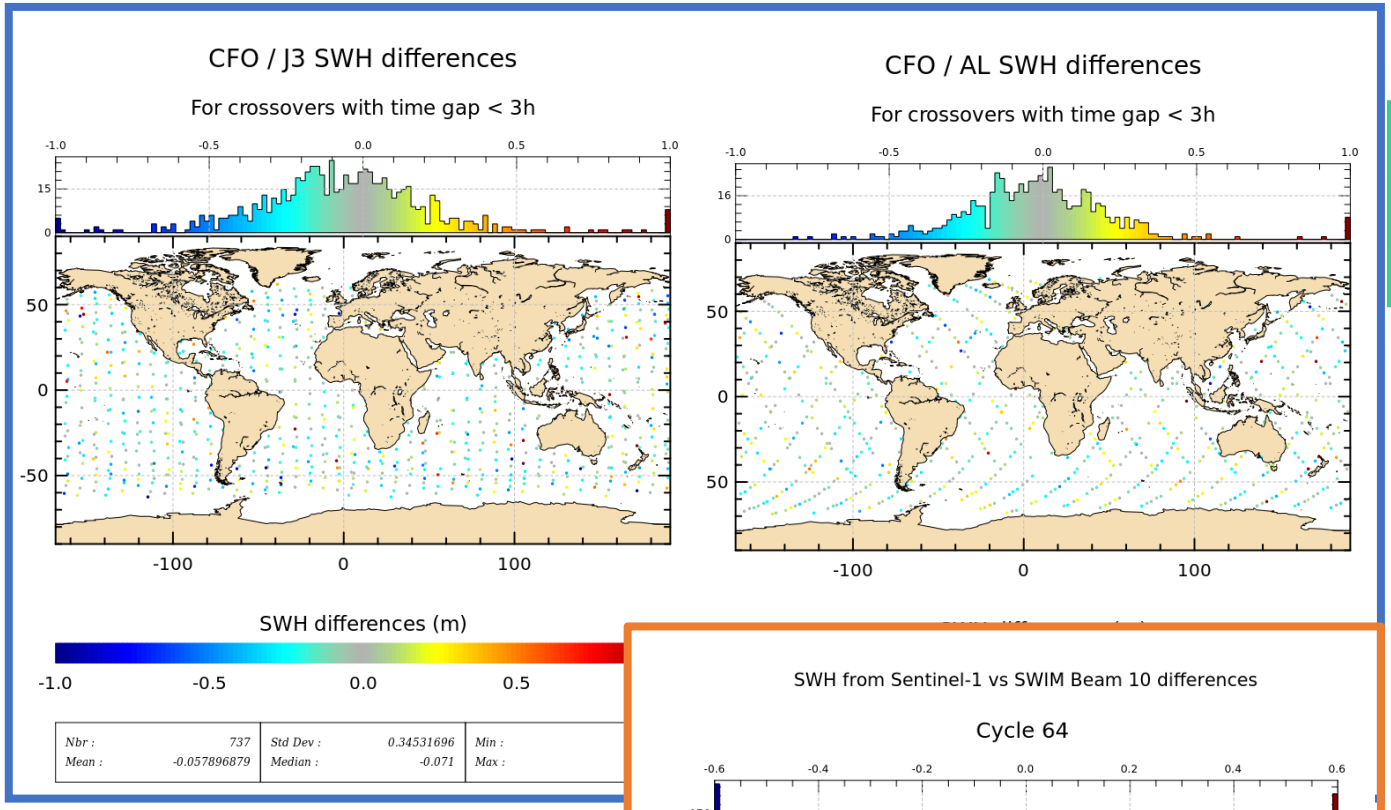
Permanent comparison possible between:

- ✓ Nadir and Off nadir
- ✓ Models



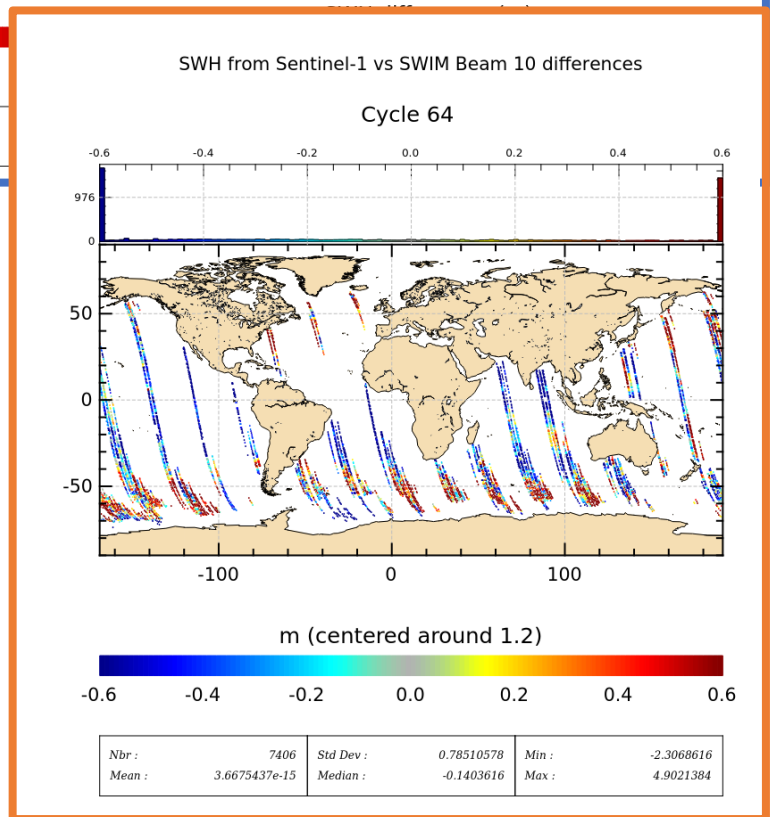
Lots of crossover points



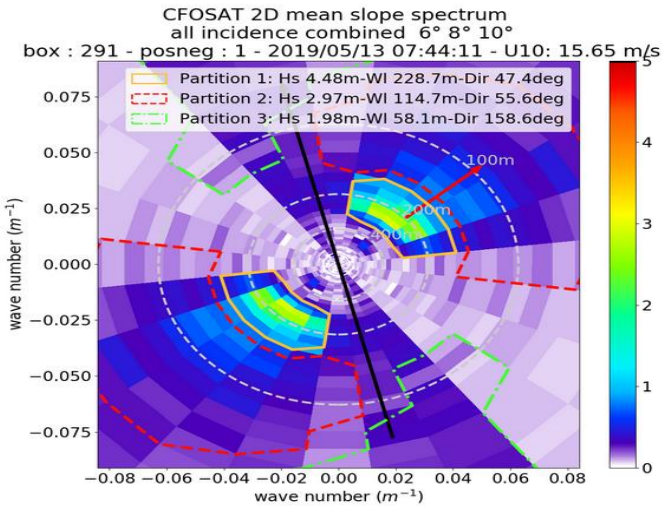


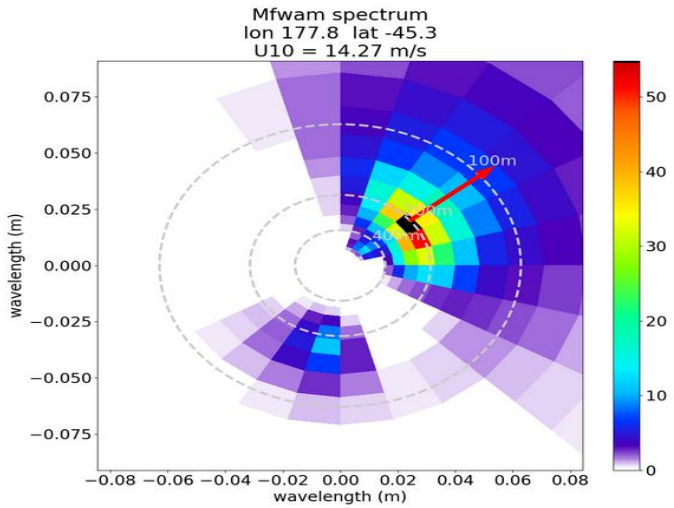
Significant crossovers zones (less than 3h) with:

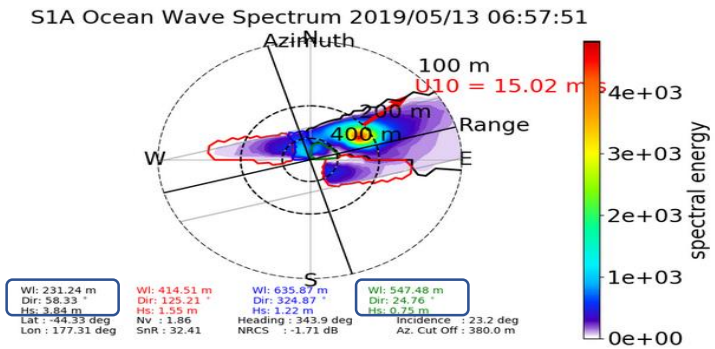
- ✓ Other nadir missions
- ✓ Sentinel1 A and B

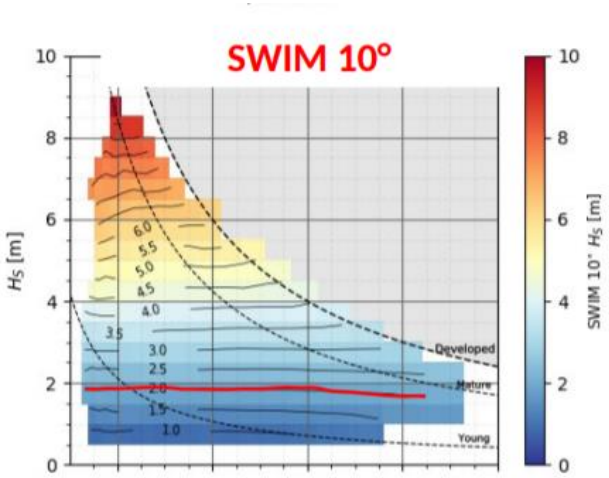


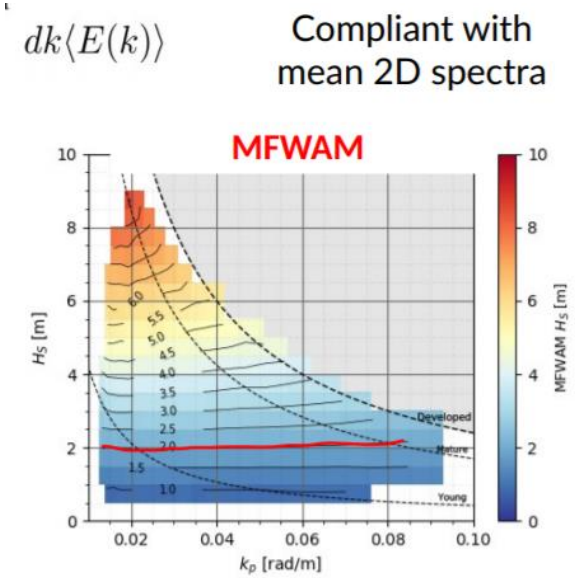
Studies and bias estimation between SWIM Sentinel1 and WAM

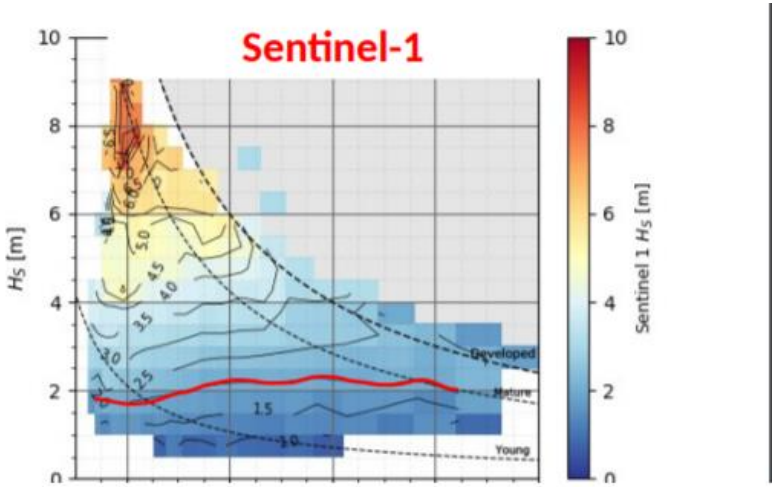












Tout afficher

For CCI …

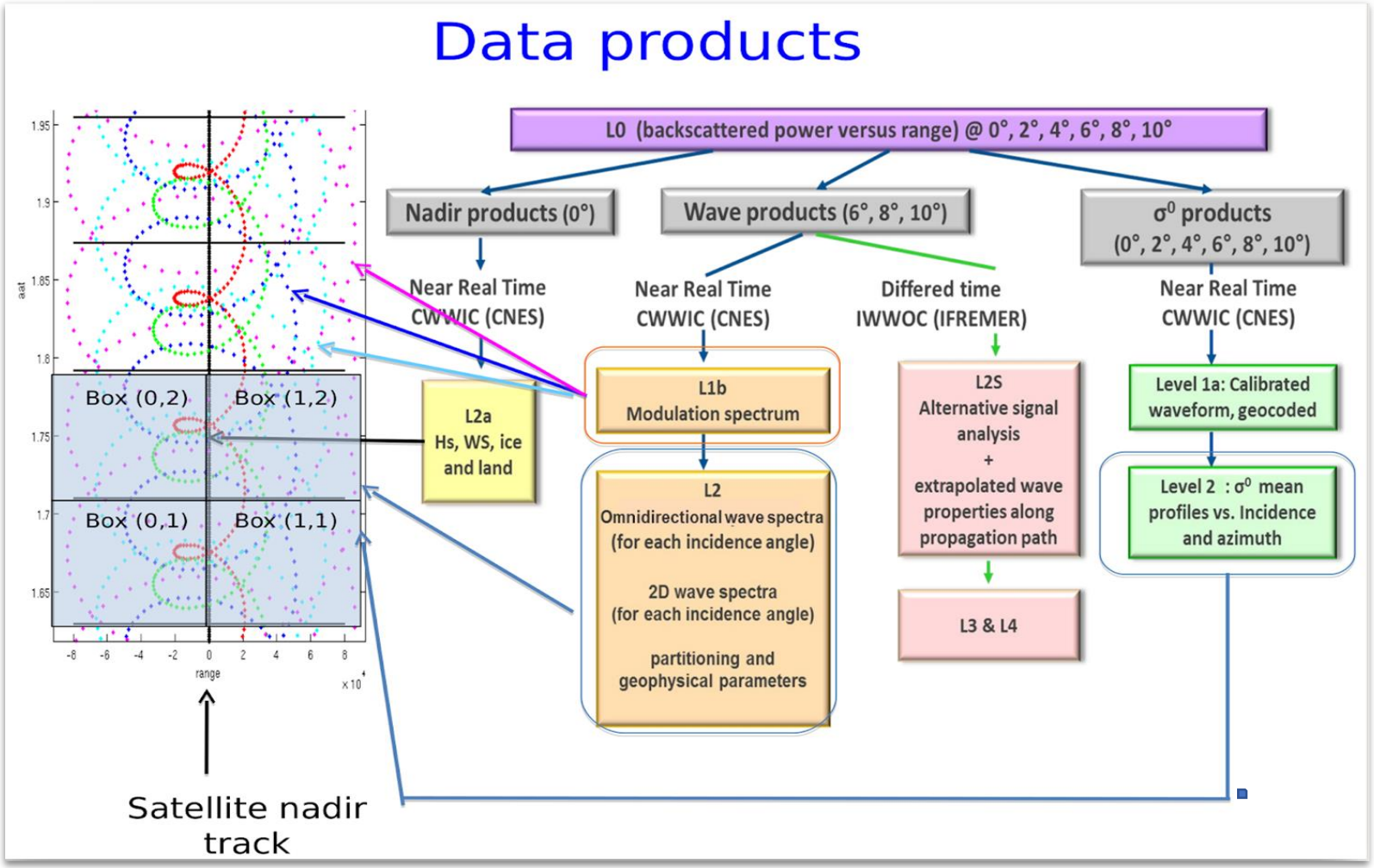
Depending on the CCI users needs, further work needed:

- ✓ **Compute biases between SWIM and the referenced CCI dataset**
- ✓ **Analyse the crossover datasets**
- ✓ **… TBD**

Possibility to :

1. **Use the current dataset available for expert users or**
2. **Use dedicated application products and rely on the calval group**

L0-L2 products: exhaustive for experts studies



SWIM products are complex because:

- ❑ The mission is innovative
- ❑ The different levels of the ground segment are often updated to get improved

➔ Need to be exhaustive, with many expert fields.

L2P: Simplified products

L2 products containt:

- 159 fields
- More than 40 flags
- 12 types of spectrum:
  - 2D slope and modulation spectrum
  - 1D omnidirectional slope spectrum integrated over all azimuth
  - All of them declined for beam 6, 8, 10, and combined
- 9 types of wave estimation
  - 5 for nadir (1hz,nsec,native,nbox,models)
  - 12 for off nadir (each beam+combined x3 partitions,models)

L2P products containt:

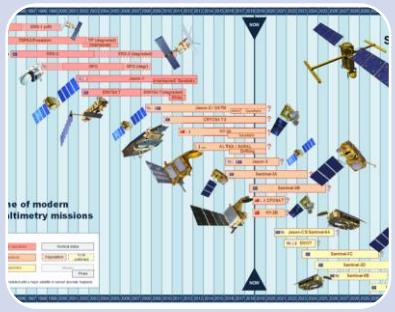
- Less than 12 fields
- 1 or 2 flags
- 1 type of spectrum
- 1 types of nadir Hs
- 4 types of wave estimation
  - 1 for total spectrum
  - 3 for the partitions

L2P: simplified products for application studies

Calval group works at qualification of the mission with these products in order to find out :

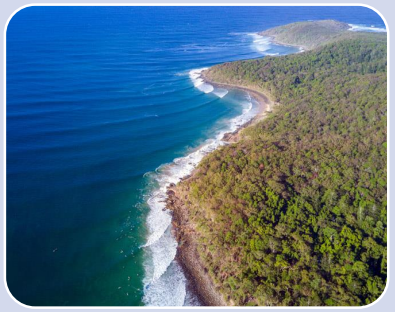
The best usefull fields adapted for different application users, at a given step of the calval studies.

The current work streams

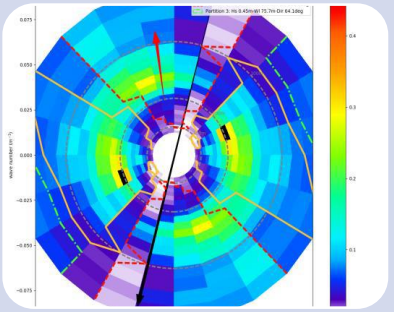


Nadir 1Hz for near real time computation

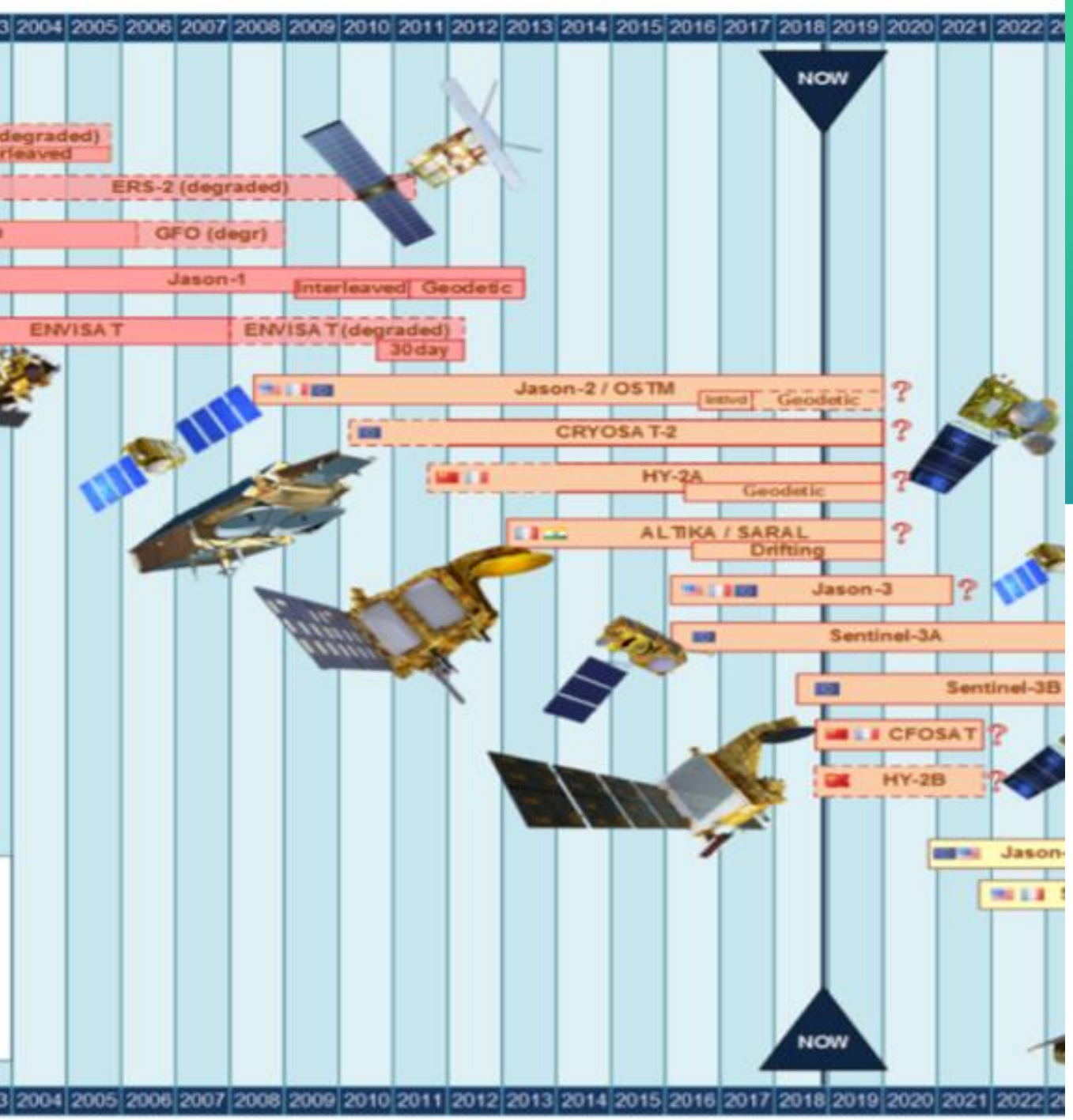
Nadir Climate oriented



Nadir 5Hz for coastal applications



Off nadir simplified



Nadir 1Hz for L3 computation

L2P/ L3 1Hz nadir product like the others…

Level-2 → Level-2P → Level-3 → Level-4

- ✓ **Since July 2019**
- ✓ Nadir 1Hz L2P/L3 are delivered to CMEMS similarly to other nadir missions AltiKa, Jason3, HY2B, S3…
- ✓ The high frequency and noise is reduced thanks to the Quilfen et al. EMD method.

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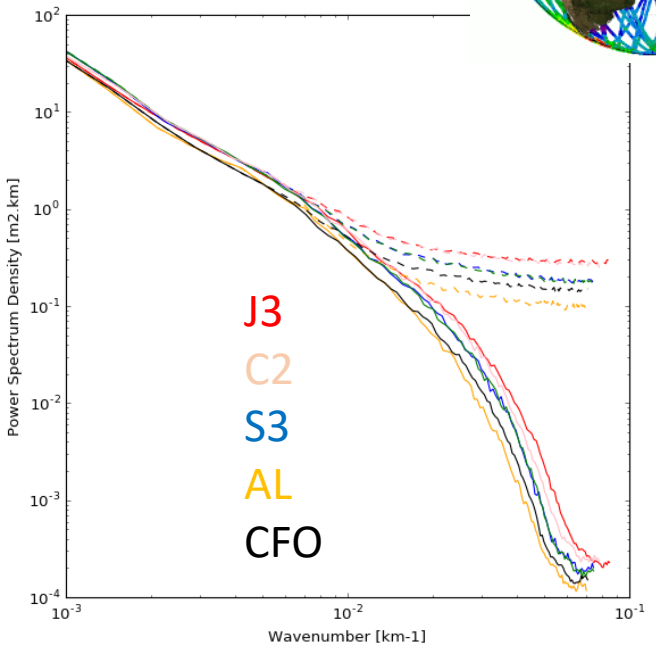
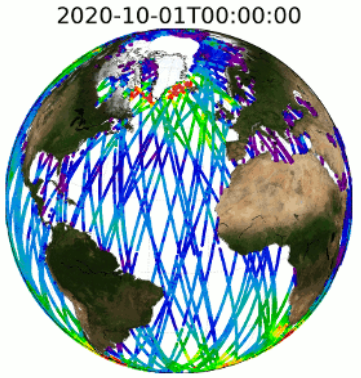
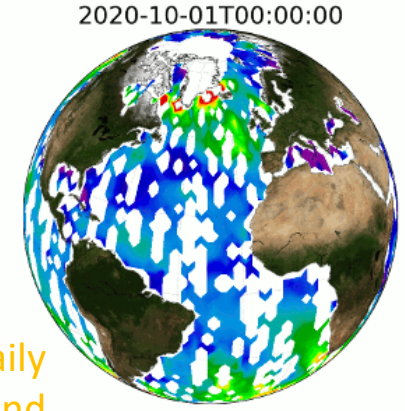
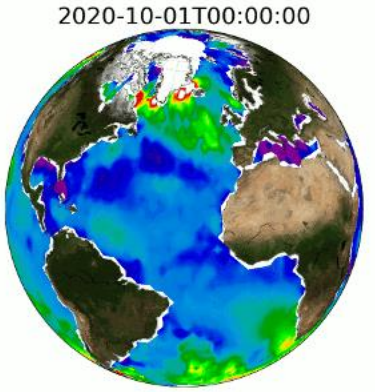


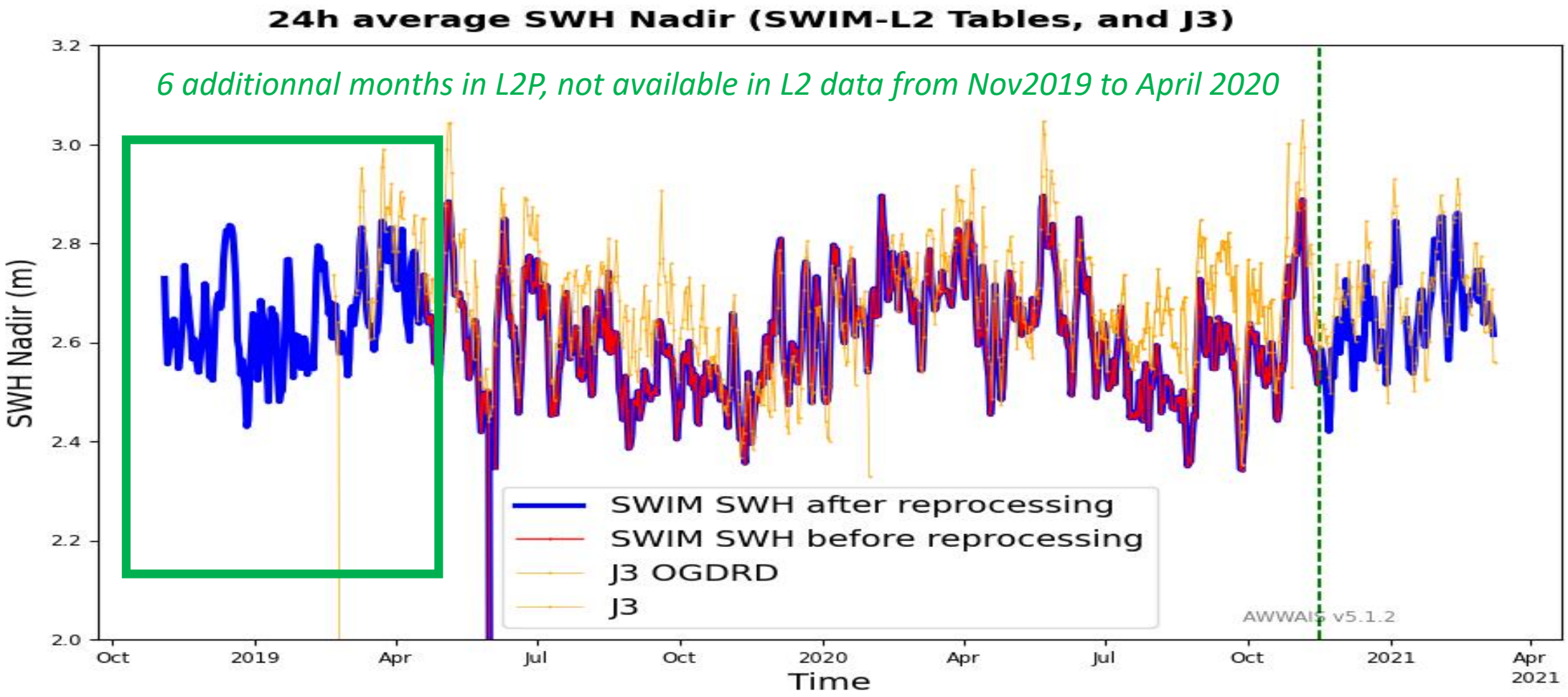




Daily and Instentaneous gridded fields



For CCI, possibility to enlarge the duration of 6months

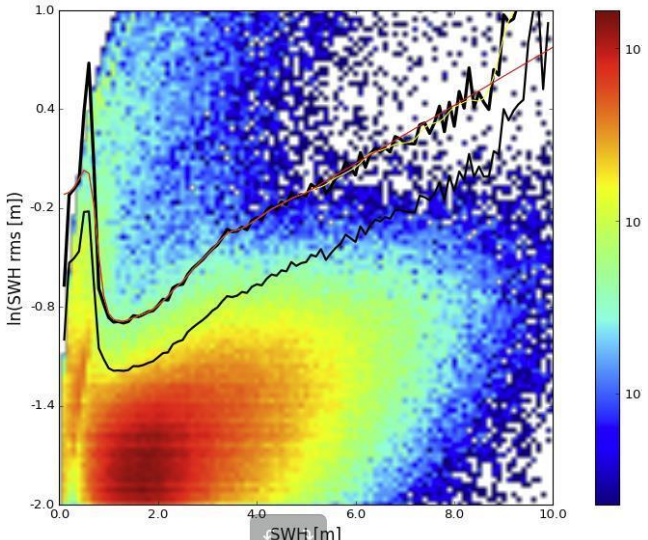


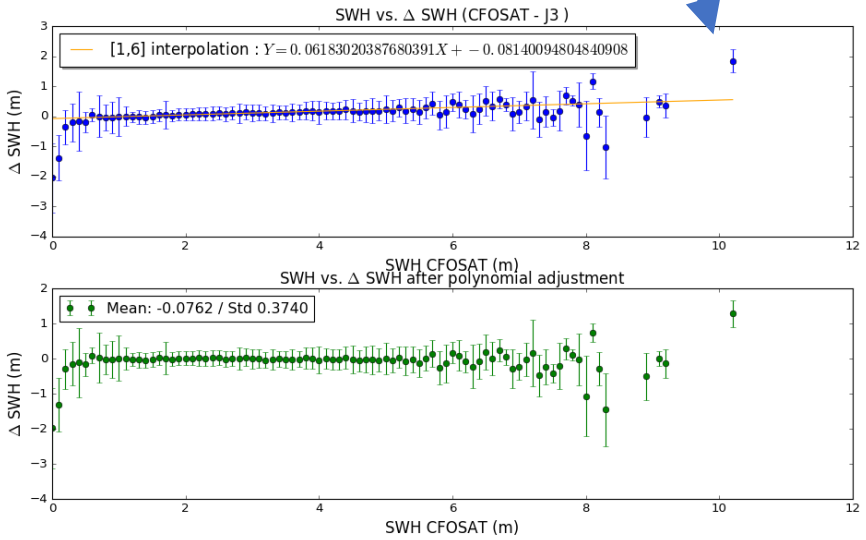
Usually in the CMEMS

- ✓ **Easy comparison to other nadir missions:**
- ✓ Provided in near real time (3h) and with a 1Hz sampling
- ✓ Based on a selection of valid data from quality criteria (based on Queffelou 2018),
- ✓ And bias alignment to buoys networks via an intermediate abacus (based on crossover bias reduction) to fit to J3 mission (GDR retracking)

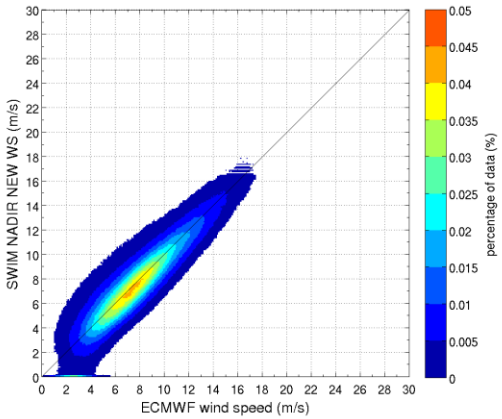
L2P products containt:

- ❑ Less than 12 fields
- ❑ A validation flag
- ❑ 1Hz nadir SWH data
- ❑ 1Hz nadir sig0 derived wind
- ❑ The abacus to fit to J3 mission
- ❑ The abacus to fit to the buoys



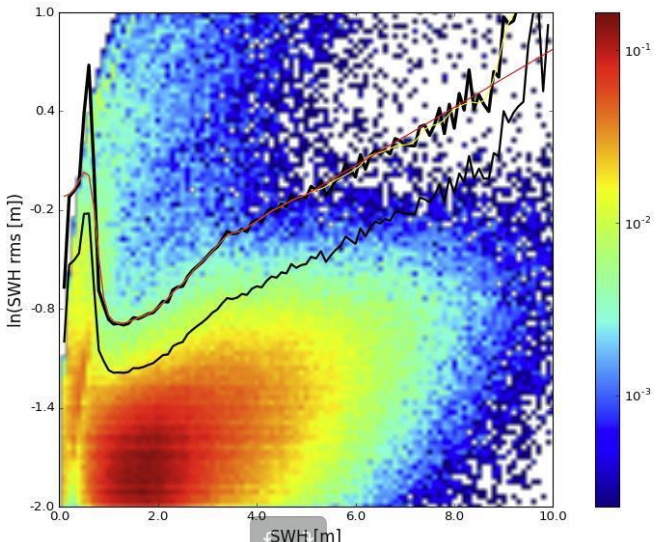


Wind inversion model (Collard et al. [2005]) computed over 6 months



For CCI needs…

- ✓ **Further work needed:**
- ✓ Could be provided off line and with a 1Hz sampling (6 more months)
- ✓ Based on a selection of valid data from quality criteria (based on Queffelou 2018),
- ✓ Necessary to get from CCI project the abacus adapted to the CCI retracking (ALES)



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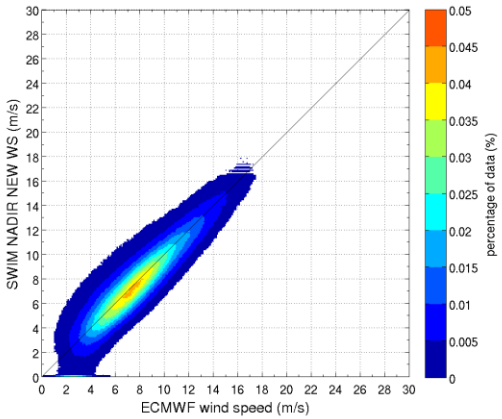
J3 time series needed

L2P products containt:

- ❑ Less than 12 fields
- ❑ A validation flag
- ❑ 1Hz nadir SWH data
- ❑ 1Hz nadir sig0 derived wind
- ❑ The abacus to fit to J3 mission
- ❑ The abacus to fit to the buoys

Wind inversion model (Collard et al. [2005]) computed over one year (Tran 2021)



Nadir 5Hz for coastal applications

L2P/L3 5Hz: applications for strong gradient area

✓ **Planned for July 2021**

- ✓ **For high frequency and coastal studies studies:**
  - ✓ **To take advantage of the very small noise on nadir data (see Tourain et al. 2021)**
- ✓ **A dedicated validation flag will be derived with a close look at:**
  - ✓ **Coastal areas**
  - ✓ **High variability areas (strong currents, Ardhuin et al…)**
- ✓ **This dataset will be proposed to compute L3 demonstration product for CMEMS internal users**
- ✓ **It could improve potential future coastal HF modeling (see Alice Dalphinet (MeteoFrance) work)**

L2P products containt:

- ❑ Less than 12 fields
- ❑ A validation flag
- ❑ 5Hz nadir SWH data
- ❑ 5Hz nadir sig0 derived wind

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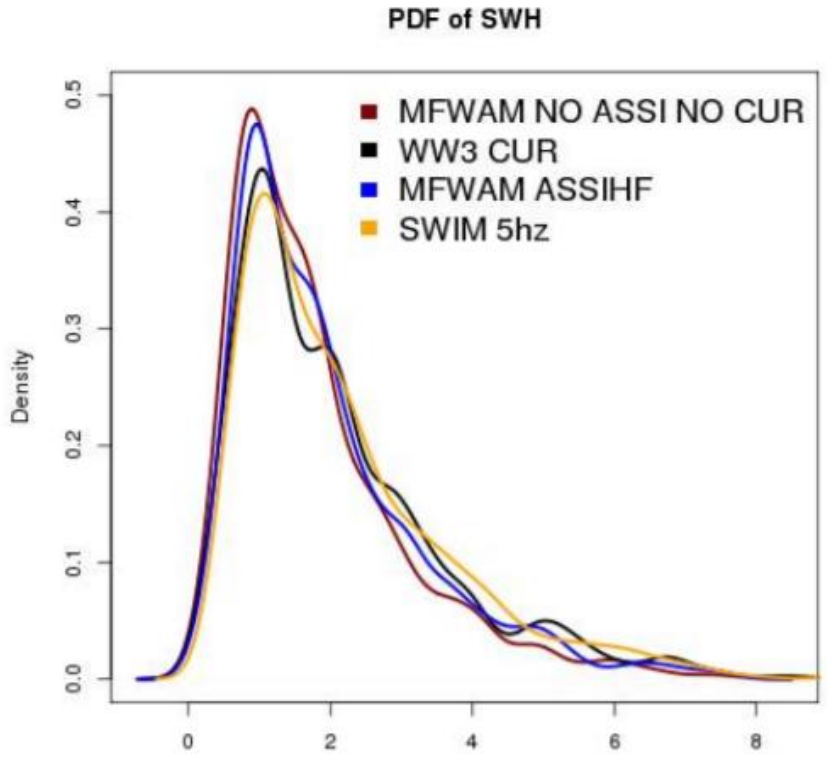
From A. Dalphinet et al. #2nd ST CFOSAT meeting

Conclusion

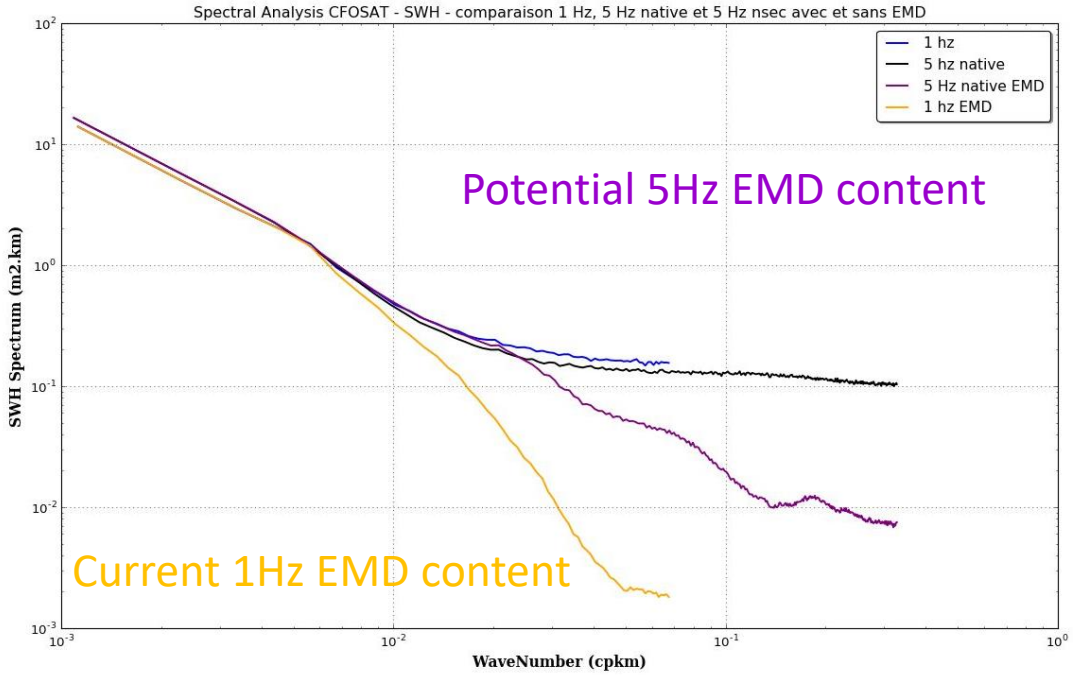
- Slight but positive impact of the assimilation of high resolution data rather than 1hz data in regional wave model (0,05° and less)
- Better and finer possibility of filtering, particularly relevant nearshore
- Good agreement with HR coastal model, in shallow water and high currents area
- Perspectives to use 5hz data in the assimilation of regional models and for the validation of coastal model



For good regional wave simulations :
- need of currents forcing
- need of high resolution altimeter data

For CCI further needs…

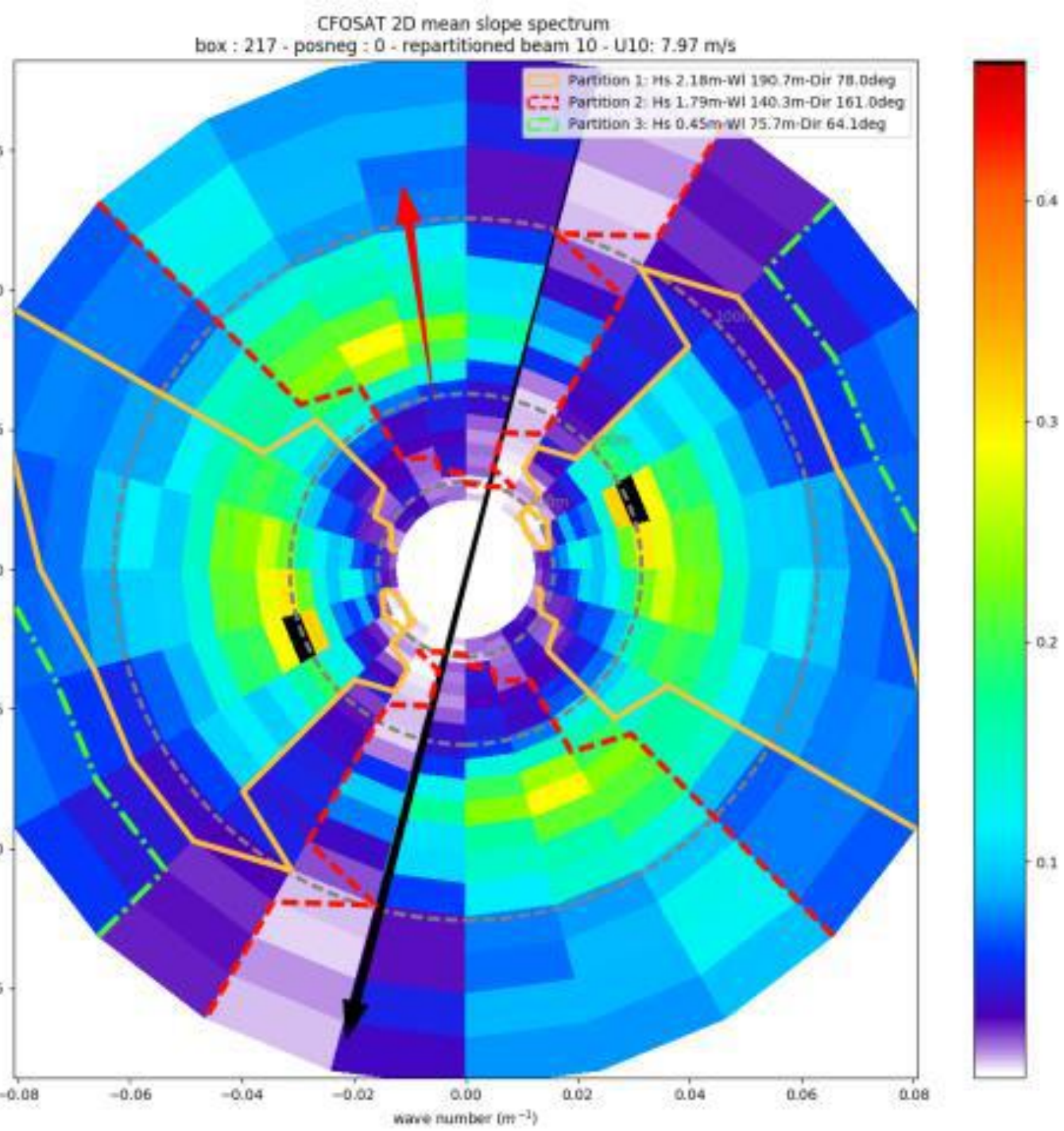
- ✓ **Coastal areas, high frequency resolution can also be of interest for climat**
- ✓ **Would need a comparison with other missions with the same adaptive processing or low noise processing (including LR-RMC for S3)**
- ✓ **Additionnal 20Hz ➔ 5Hz compression…**



L2P products containt:

- ❑ Less than 12 fields
- ❑ A validation flag
- ❑ 5Hz nadir SWH data
- ❑ 5Hz nadir sig0 derived wind

- ✓ **Apparently possible to apply the EMD filtering (Quilfen and Chapron 2019) as well, further work needed, on going**



OFF-Nadir simplified products

L2P: OFF-Nadir simplified products

✓ **V0 Planned for March 2021**

- ✓ **For user friendly look at off nadir:**
  - ✓ **SWIM 2D Spectrum**
  - ✓ **The associated wave parameters: (Hs, Direction, Wavelength)**
- ✓ **A dedicated validation flag to be confident in :**
  - ✓ **The spectrum**
  - ✓ **The partitions**
- ✓ **This version is a sub ensemble of the L2 dataset.**
- ✓ **Based on calval studies (See Hauser, Aouf, Peureux… talks in ST meeting) the chosen spectrum is the Beam10 which shows better behaviors.**

L2P products containt:

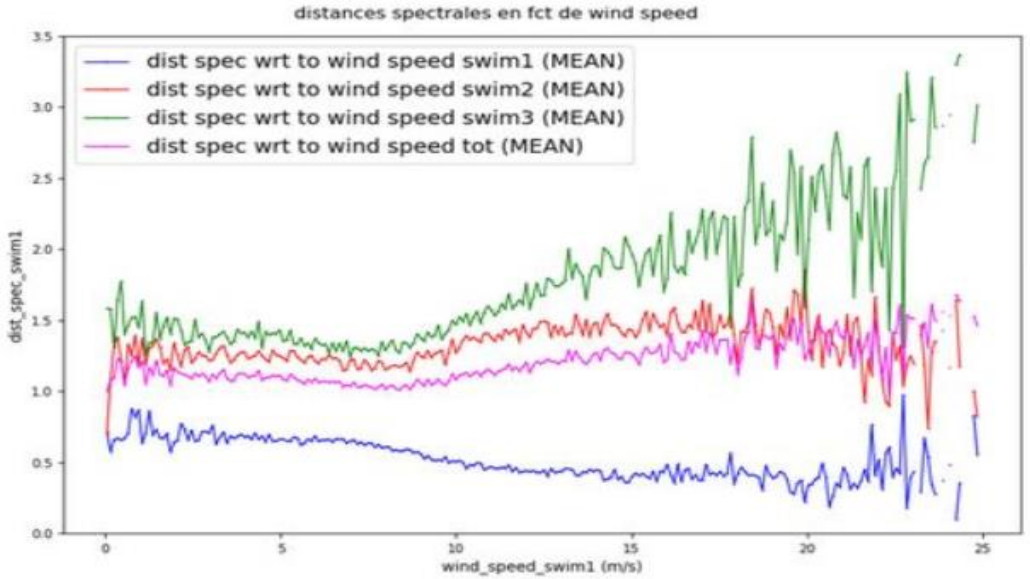
- ❑ Less than 12 fields
- ❑ 1 Valid spectrum flags
- ❑ 1 valid partition flag
- ❑ 1 type of spectrum
- ❑ 1 types of nadir Hs (nbox)
- ❑ 4 types of wave estimation
  - › 1 for total spectrum
  - › 3 for the partitions
- ❑ 1 type of nadir Wind (nbox)

L2P: OFF-Nadir simplified products

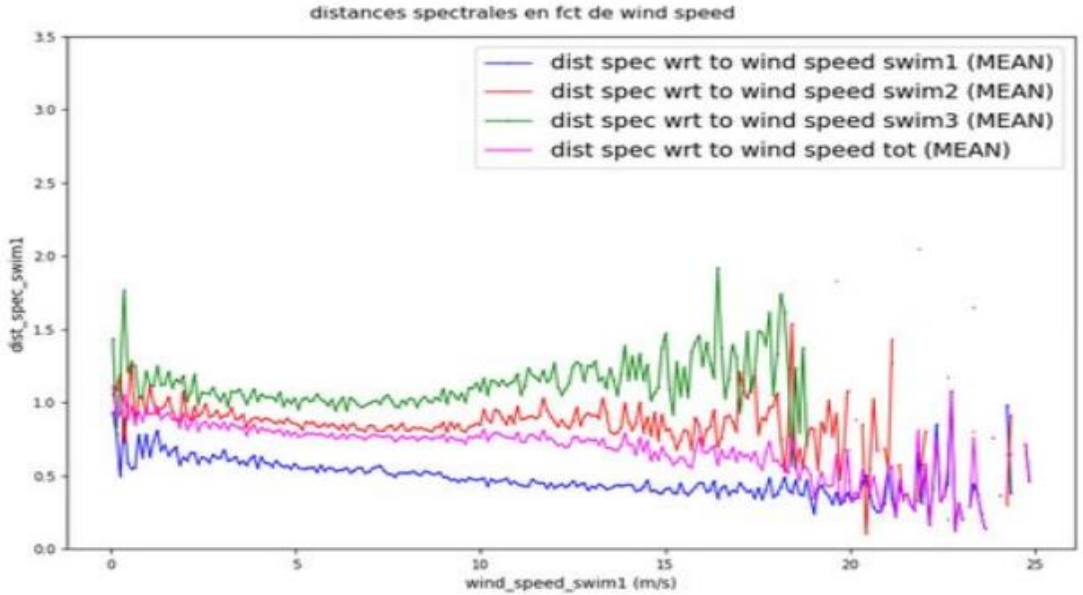
- ✓ **V1: Potential evolutions (under validation)**

- ✓ **Studies are ongoing to propose an improved partitioning of the spectrum**
  - ✓ **After cross-assignement, based on a minimisation of the spectral distance**
  - ✓ **Preliminary results are promising to be more consistent with WAM model**

Blue -> partition swim 1 ; Red -> partition swim 2 ; Green -> partition swim 3

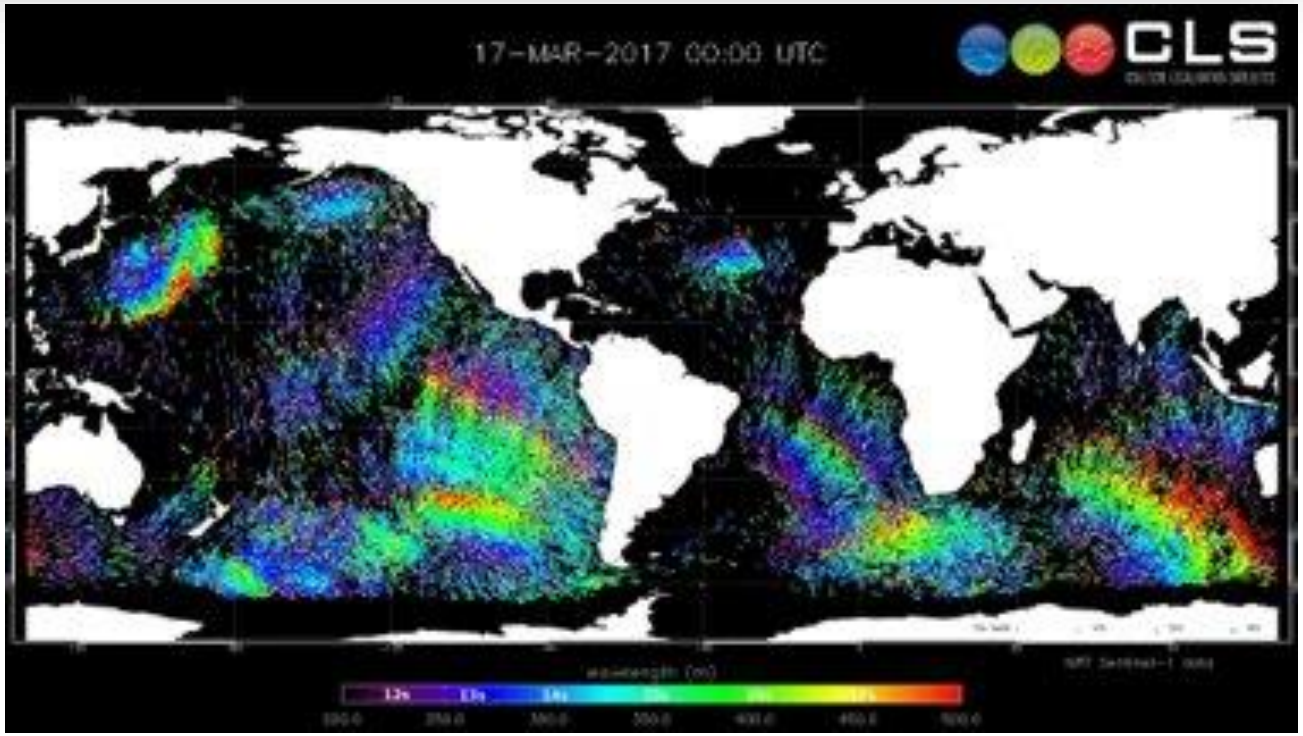


L2 Data



L2P Data

L2P: OFF-Nadir simplified products for L3



- ✓ These dataset will be proposed to compute L3 demonstration product for CMEMS internal users (fireworks)
- ✓ Depending on calval studies and users returns, it could be improved until its introduction in the official catalogue in November 2021
- ✓ Several improvements are under analysis and could be added to the product in particular, an improved new partitioning method
- ✓ These data will be complient with Sentinel-1 products available on CMEMS
- ✓ The validation and comparisons to this mission are on going

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CFOSAT L2P products: Have a try!

- ✓ **Offering the CalVal Team progress to the largest community**
- ✓ **Best current solutions elected by the calval team,**
- ✓ **Best data selection, thanks to a « all in one » quality flag**
- ✓ **Application oriented**
- ✓ **Homogeneous to other missions:**
  - ✓ Nadir constellation Hs and wind
  - ✓ Off nadir Sentinel One / Wave Models complient
- ✓ **User friendly:**
  - ✓ We anser your questions and claims via Aviso web site

https://www.aviso.altimetry.fr/en/missions/current-missions/cfosat/access-to-data.html

Feel free to ask or comment about the products contains and your own needs

aollivier@groupcls.com

The Team

CaSyS = Systematic Calval for SWIM team, part of SALP project supported by CNES to:

- ✓ Provide on the flow and long term analysis
- ✓ Manage the reprocessing validation
- ✓ Work on the L1B, L2 prototype chains
- ✓ Promote and valorise CFOSAT products
- ✓ Be part of all project caval discussions jointly with:

Distribution expected calendar

Off nadir products.

- February 2021: V0 L2P Off nadir
- May 2021: V1 Off nadir with new partitions
- November 2021: V1 With future improvements

Nadir products.

- July 2019: V0 1Hz nadir L2P
- February 2021: V0 1Hz climat reprocessed time series from April 2019
- July 2021: V1 1Hz Climate longer time series from Nov 2018 with CCI complience
- November 2021: V0 5Hz Coastal nadir L2P